

## DEPARTMENT OF METHODS, REVIEWS, ABSTRACTS, AND BRIEFER ARTICLES

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### THE LITERATURE OF DIATOMS

BY

FRED B. TAYLOR  
Bournemouth, England

The literature on the subject of diatoms is both extensive and expensive; many of the books are long out of print; much is scattered through periodicals English and foreign; and there is no recent general hand-book at a moderate price. The nearest approach to such a volume is in German, it is the part on Peridinales and Bacillariales in Engler and Prantl's *Pflanzenfamilien*, published at Leipzig in 1896. It is written by F. Schuett, and gives an account of the morphology and biology of diatoms, with a scheme of the genera divided into Centricae and Pennatae, a description of each genus then established, and a drawing of one or more species to illustrate the genus.

The *Diatomaceae of the Hull District* by Mills and Philip contains several plates covering most of the species commonly found in England. There is also a most instructive paper by Philip in the *Transactions of the Hull Scientific and Field Naturalists' Club* vol. IV. part iv (1912) p. 205, on *Diatoms of the Humber*.

For fresh water diatoms *Die Süßwasser Flora Deutschlands, Oesterreichs, und der Schweiz*, part 10, by H. von Schönfeldt deals with diatoms, it is published by Fischer of Jena, and contains many figures of English diatoms.

The early history of our knowledge of the *Diatomaceae* is given by Ehrenberg in the introduction to the *Bacillaria* in his first great work, *Die Infusionsthierchen*, published in 1838. Kitton in *Science Gossip*, 1880, pp. 78 and 133, gives a résumé of this introduction, which describes the work of Ehrenberg himself and other diatomists. Kitton also gives an interesting account of the views of Corda (1835) in *Science Gossip*, 1882, pp. 6, 22. The imperfection of the instruments then available, and the then commonly received belief in the animal nature of diatoms often led to the enunciation of opinions, which now appear ridiculous.

Kuetzing's *Kieselschaligen Bacillarien*, (1844), also contains an historical preface. This was translated by Professor H. L. Smith of Geneva, U. S. A. in nos. 2 and 4 vol. II of *The Lens*. A résumé of this translation with comments of his own was given by Kitton in *Science Gossip*, 1874, pp. 2, 25, 149.

Ehrenberg may be regarded as the father of diatomology, he was able to command a vast quantity of material; and although many of his views are now known to be erroneous, and many of his figures are incorrect or insufficient owing to the imperfect objectives he used, and to the want of sufficient magnification, his labors will always be of great value to the diatomist. About one third of the genera now recognized were founded by him. After him Greville and Grunow are the most prolific creators of genera, accounting for about another third between them.

Diatom literature may be taken as starting with Agardh's *Systema Algarum* in 1824, and Ehrenberg's early papers on the Infusoria, in which he included diatoms, published in 1829-1832. Kuetzing's *Synopsis Diatomearum* followed in 1834, and in 1838 Ehrenberg brought out his great work on Infusorial Animalcules, *Die Infusionsthierchen*, nine of the 64 plates being devoted to diatoms.

Kuetzing's second work, *Die Kieselschaligen Bacillarien*, 30 pl. was published in 1844; the following year saw the first edition of Pritchard's *Infusoria*, further editions were issued in 1852, 1861, and 1864. The part on the Diatomaceae was written by Ralfs, and plates iv to xvii give figures of diatoms. This is, perhaps, the book on diatoms most readily accessible to English students, and though portions of it are out of date or incorrect, it forms a very useful introduction to the subject.

Rabenhorst's *Süsswasser Diatomaceen*, 10 pl., appeared in 1853. Owing to the imperfection of optical apparatus many of the figures in these earlier works are wanting in detail. It is therefore often difficult to determine the identity of the species named and described; yet it is wonderful how much was seen and accurately recorded with instruments that would now be despised and rejected.

The last half of the nineteenth century was a period of great activity in this branch of research. From the year 1853 to 1866 the *Transactions and Journal of the Microscopical Society*, and the *Transactions of the Royal Society of Edinburgh* contain a number of papers by Brightwell, Gregory, Greville, Lauder, Roper, Walker-Arnott, Wallich and others, many of which are beautifully illustrated by Tuffen West. William Smith's *Synopsis of British Diatoms*, containing 69 plates by the same artist was published in 1853-1856; Gregory's *Diatoms of the Clyde* appeared in 1857 (*Proc. Royal Soc. Edinburgh*, vol. xxi, p. 473). The figures were drawn by Greville.

Ehrenberg's colossal *Mikrogeologie* appeared in 1856. Besides his two large books he wrote numerous papers on diatoms in the *Transactions of the Berlin Academy of Science*. Naturally in the course of the progress of knowledge, and with the improvement of instruments, and the increase of material, the early conceptions of many genera and species have been modified, and relations have been acknowledged between forms at first

sight widely differing. The *Micrographic Dictionary* first appeared in 1854, with enlarged editions in 1859, 1872, and 1882. It contains several plates of diatoms.

Greville's fine series of 20 papers on New and Rare Diatoms, mostly from Trinidad, Barbadoes, Moron, Monterey, and Ceylon, appeared in the *T. M. S.* and *Q. J. M. S.* from 1861 to 1866, with monographs on *Asterolampra*, *Campylodiscus*, and *Auliscus*. He also wrote on Diatoms from Hongkong (*A. M. N. H.* 1865), the South Pacific (*Edin. N. P. J.* 1863) and *The Tropics and Southern Hemisphere*, (*T. B. S. Edin.* and *Edin. N. P. J.* 1865, 1866). A collection of poor photographic reproductions of 81 plates mostly Greville's from *T. M. S.*, etc., compiled by Moebius was published in New York. It is sometimes on the market.

In America J. W. Bailey wrote on American Bacillaria, and published several papers between 1841 and 1860. L. W. Bailey also wrote on the subject, and numerous papers by Dr. A. M. Edwards appeared in various periodicals between 1859 and 1877; his sketch of the *Natural History of the Diatomacea* is dated 1874; (cf. *Bull. Torr. Bot. Club*, 1877 p. 34). Lewis wrote in 1861 on *New and Rare Diatoms*, and in 1865 on *White Mountain Diatoms*.

Cleve, a Swede, began to write in 1864, and published various papers and books, many of them in English, on Diatoms from Spitzbergen, the Sea of Java, West Indian Archipelago, Greenland and Argentina, and Finland; also on Arctic Diatoms, and *New and Little Known Diatoms*, and on the diatoms found by the *Vega Expedition*, and later, several papers on *Plankton Diatoms*. His great work is his *Synopsis of the Naviculoid Diatoms* published in 1904, 1905. In this last book he proposes a rearrangement of the *Naviculae* and the related genera setting up a number of new genera, which have not been universally accepted; although many of them are recognized as useful subdivisions of the older genera; some writers, however, accept his proposals en masse.

Grunow, an Austrian, wrote from 1860 to 1890; his papers on *New Diatoms*, and on *Austrian Diatoms* (1860, 1862, 1863, and 1882 and 1883) are important contributions to diatom classification; and much of his work is embodied in Van Heurck's *Synopsis of the Diatoms of Belgium*, and in Schmidt's *Atlas*. His account of the diatoms of the *Novara Expedition* is dated 1867; the same year saw his paper on the diatoms of the *Sargasso Sea of Honduras*, an abstract of this is given in *M. M. J.* 1877, p. 165. He also wrote on *Caspian diatoms*, and conjointly with Cleve a book on *Arctic diatoms*, followed by his *Diatoms of Franz Josef Land*.

Kitton wrote from 1868 to 1884 a number of articles, many of them in *Science Gossip*, a magazine which during the years 1867 to 1877 printed several useful papers on the subject of diatoms, including some by Kitton on *North American deposits*. Kitton translated some of Grunow's

papers for various English periodicals; among these were the Novara diatoms, which appeared in *Grevillea* in 1872.

Harting's *Banda See*, Janisch on Guano diatoms, Janisch and Rabenhorst on the Marine Diatoms of Honduras, Heiberg's Danish Diatoms, and Schumann's Prussian Diatoms belong to the early sixties.

In the seventies followed De Brébisson on Diatoms contained in Corsican Moss. He had previously written on diatoms from the Cherbourg littoral, and wrote other papers.

Donkin published only three parts, (12 plates), of his *Natural History of the British Diatomaceæ*. About the same time appeared O'Meara on Irish Diatomaceæ (poor plates) and on diatoms from Kerguelen's Land; and Petit on Table Bay, Campbell Island, Cape Horn, etc. In 1872 Pfitzer wrote on the structure and development of diatoms; an abstract of this important paper is given by O'Meara in *Q. J. M. S.* 1872, p. 240. The *Lens*, published in Chicago, only lived two years, 1872, 1873. It contains valuable articles by Professor H. L. Smith and other American diatomists; among these is the professor's Classification of diatoms into Rhabdidiæ, Pseudo-Rhabdidiæ, and Crypto-Rhabdidiæ, which was followed by Van Heurck and De Toni, and by most diatomists until the present division into Centricæ and Pennatæ, (a modification of it) appeared. Many French diatomists follow Pfitzer's division into Placochromaticæ and Coccochromaticæ, which is based upon the nature of the endochrome.

In 1874, Adolf Schmidt, a canon of Aschersleben, commenced his splendid work, *Atlas der Diatomaceenkunde*. This is published in parts of four plates issued at irregular intervals. An index to the first four series, 240 plates, has been published. Up to August 1914 parts 1 to 79, containing plates 1 to 316 had appeared: parts 80-83 have been published since the war. Adolf Schmidt died in 1901, but the *Atlas* has been continued by his son and by Fricke, Heiden, and Hustedt, with the assistance of Cleve, Grunow, and other diatomists.

J. Brun of Geneva entered the field in 1880 with his *Diatomées des Alpes et du Jura*; following in 1889 with *Diatomées Fossilies du Japon* written in collaboration with Tempère; and in 1891 with *Diatomées, Espèces Nouvelles*. The plates in the two last are excellent: the first commences with an important sketch of the natural history of diatoms.

In 1886 Count Castracane's report on the diatoms found by H. M. S. Challenger was issued by the British Government. This contains 30 plates and valuable notes. Peragallo's *Villefranche* appeared in 1888 and Wolle's *Diatomaceæ of North America* (112 plates) was published in 1890. The plates are mostly copied from other authors, and are far behind the originals in execution; but the book is useful for reference, and is generally procurable at a moderate price, considering its size.

Le Diatomiste edited by Brun, a periodical devoted to the study of diatoms, only lived from 1890 to 1896. It contains many notable contributions including monographs on Pleurosigma and Rhizosolenia by Peragallo, on Entogonia by Bergon, and on the miocene diatoms of Barbadoes by Brun and Barbo.

Le Micrographe Préparateur under the editorship of J. Tempère ran from 1893 to 1906. It contains valuable papers on the structure and reproduction of diatoms, on the movement of diatoms, and on mounting and cleaning. But the most important is Les Diatomées Marines de France, of which some 115 plates were published in this periodical; the complete work, 137 plates, was separately published in 1908.

Leuduger-Fortmorel between 1879 and 1898 published books on the diatoms of the north coast of France, Ceylon, Malaysia, and West Africa.

In 1886-1887 in the Journal of the Quekett Microscopical Club appeared the well known paper on the Oamāru deposit in New Zealand by Grove and Sturt; also in 1886 Pantocsek published the first volume of his great work on the fossil diatoms of Hungary. The second volume appeared in 1889, and the third in 1892. The whole contains 102 plates. In the third volume are many new forms from Kusnetzki in Russia, and from fossil deposits in Japan. A second edition was issued in 1903-1905. Pantocsek has also written on the diatoms of Lake Balaton (Platten See), and of Kertsch, and of Szliacs in Hungary, (1902, 3). About this time Walker and Chase, and Kain and Schultze wrote on diatoms in America, the latter pair bringing to notice the interesting deposit of Atlantic City.

Van Heurck's Synopsis des Diatomées de Belgique, (1880-1885) contains 141 plates, and is a work of the greatest value. His Treatise on Diatoms translated into English by Dr. Wynne Baxter, was published in 1896 before the original; it contains 35 plates illustrating all the species found in the North Sea and the neighboring countries; and in the text are descriptions with typical figures of all the genera known at the time of publication, some 193 in number. Otto Witt in 1885 gave an account of the diatoms from the marine deposits of Ananino and Archangelsk in the province of Simbirsk in the interior of Russia.

Rattray's monographs on Aulacodiscus (J. R. M. S. 1888); Auliscus (J. R. M. S. 1888); Actinocyclus (J. Q. M. C. 1890); and Coscinodiscus (Proc. Royal Soc. Edin. 1890) are standard authorities.

About the same time appeared Pelletan's Les Diatomées, he was assisted by Deby, Petit and Peragallo. The account of the natural history of diatoms is good, and there are numerous illustrations of the most common species and genera. Truan and Witt's book on the fossil deposit of Jérémie in Haiti is dated 1888. Another work of great utility, though it is not illustrated, is Les Diatomées du Mond Entier, issued by Tempère and Peragallo as a companion to the series of 625 slides from various locali-

ties distributed by them. It gives lists of the diatoms found by them on the slides, and is a valuable aid to identification. A second series of 1000 slides is accompanied by a volume bearing the same title, the second edition of this is dated 1915; it is of course more comprehensive.

Deby's monograph on *Campylodiscus* appeared in 1891; with three or four exceptions the figures are copied from other works. About the same time a portion of Janisch's report on the diatoms of the Gazelle Expedition was privately distributed to certain favoured diatomists without text or list of contents. This work has never been completed; out of 22 plates numbers 7, 8, 10, 12, 13, 14, 17, and 18 are wanting. Many of the specimens figured are reproduced in Schmidt's Atlas.

In 1891 to 1894 De Toni, a professor of the University of Padua, published his monumental work, *Sylloge Bacillaricarum* as part of his *Sylloge Algarum*. This book has no illustrations, but it contains in Latin descriptions of all the genera and species described or named at the date of publication, with their synonyms and varieties, and references to all published figures and drawings. Nearly 6000 species are admitted. The book also contains a bibliography to date of the literature of diatoms by Deby.

Frère Héribaude of the college of Clermont-Ferrand wrote in 1893 on the diatoms of Auvergne. The volume commences with a short, but very clear, instructive, and succinct account of the subject, forming an admirable introduction to the study of diatoms. Between 1902 and 1908 he published four memoirs on the fossil diatoms of Auvergne.

In 1896 Schuett wrote the part on diatoms in Engler and Prantl's *Pflanzenfamilien*, (lieferung 143-145). This book, with its one or more typical figures of each genus, and its account of the morphology and biology of diatoms, forms a most useful handbook at a moderate price. It gives a description of all known genera classified as *Centricæ* and *Pennatæ*, the division now generally adopted; the *Pennatæ* are since 1902 subdivided into *Mobiles* and *Immobiles*, the *Centricæ* are all *Immobiles*. This last distinction is due to Mereschkowsky, a Russian diatomist: (*Script. Bot. Hort. Imp. Petrop.* 1902) and *A. M. N. H.* 1902, p. 65).

Karsten's book, *Die Diatomeen der Kieler Bucht*, 1899, is praised by Cleve and Mereschkowsky as a *vade mecum* for students of living diatoms.

In the present century we have Dippel's book on the Rhine and Maine districts, 1905; and a most useful and instructive report by Mann on the diatoms found in the Pacific by the U. S. ship *Albatross*, published by the Smithsonian Institute in 1907. Von Schonfeldt's *Diatomacæ Germaniæ* was published in the same year.

Peragallo's magnificent work *Les Diatomées Marines de France*, (13 plates, 1897-1908), and Meister's *Kieselalgen der Schweiz*, (48 plates, 1912), contain splendid figures, and include most of the English forms.

*La Diatomologia Española* by Azpeitia, (1911, 12 plates), treats of various Spanish deposits, including Moron. This establishes two quite new genera, *Dossetia* and *Secallia*.

I must not omit mention of three important papers by Laubeg, on the Palæobotany of France, (Soc. Bot. de France. Mém. XV. Jan. 1910): the Study of Sedimentary Deposits of Diatoms (Bull. des Services de la Carte Géologique de France, Mém. 125, 1910): and on Diatoms, their Deposits and Uses, (Revue Générale des Sciences, 1911).

In *Nuova Notarisia* professor Achilli Forti has written several papers, with photographic illustrations; on Bergonzano and Marmorito deposits in 1908 and 1914; and a monograph on the genus *Pyxilla* in 1909. His paper on the classification of diatoms as *Mobiles* and *Immobiles* in 1912 was anticipated by Mereschkowsky in 1902, (Script. Bot. Hort. Imp. Petrop. Fasc. xviii. p. 96.), as I have already pointed out. Mereschkowsky has also written other papers on diatoms, and has suggested the formation of various new genera, some for new forms, and some for species already described.

West's *Algæ* (Camb. Univ. Press, 1916) devotes 43 pages to Diatoms, and compresses much information into that space. Boyer's *Diatomaceæ* of Philadelphia, 40 plates, bears date 1916: it contains a useful introduction and fine illustrations.

Considerable attention has been given during the last thirty years to the Plankton diatoms. Cleve in 1889 wrote on Pelagic diatoms from the Kattegat, and followed this by papers on diatoms from Baffin's Bay and Davis' Straits (1894), Phytoplankton of the North Atlantic (1897), Diatoms of the Jackson-Harmsworth Expedition (1898), North Sea and English Channel (1900), Swedish Expedition to Greenland (1900), and Plankton of the South Atlantic (1900). And Oestrup wrote on the Marine diatoms of East Greenland (1895, 6 plates).

Van Heurck in 1909 wrote on the diatoms found during the voyage of S. Y. *Belgica* in 1897-1899 in the Antarctic Ocean, (13 plates).

Karsten wrote the account of the diatoms found during the German Deep Sea Expedition in 1898, 1899. This is a costly and magnificent work in three parts, on the Antarctic, Atlantic, and Indian Phytoplankton, with splendid plates. Other writers on the subject are Ostfeldt, Aurivillius, Hensen, Jørgensen and Lemmermann.

The Belgian Museum of Natural History has published *Microplankton de la Mer Flamande*, by Meunier, (Tome VII. Fasc. 2, 3. 14 plates. 1913, 1915), *Nordisches Plankton, Botanischer Teil*, by Gran, 1905, contains about 180 figures of interesting and new forms. Gran also wrote several other papers on Arctic Diatoms and Plankton.

I must also note Mangin's paper on the Study of Plankton in *Annales des Sciences Naturelles*, 1908, pp. 177-219; and Bachmann on the Phyto-

plankton on Fresh Water, with special reference to the Lake of Lucerne, (1911, pub. Jena). The report of the Imperial Fisheries Institute of Japan for 1911 contains 6 plates of littoral diatoms of Japan.

It is impossible in the space of a few pages to note all the contributions to the knowledge of the structure and history of diatoms, even to name more than some of the best known writers on the subject such as Nelson, Morland, Lauby, Cox, Brightwell, Roper, Wallich, the two Müllers, Butcher, O'Donohoe, and Murray.

THURGARTON, BOURNEMOUTH.